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(19)

(54) POSITION DETECTOR

(71) We, COMPAGNIE ELECTRO-MECANIQUE a French corporate body of 12 rue Portalis, 75008 Paris, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to position detectors.

The invention provides a position detector comprising:— an oscillatory circuit including a primary winding inductively coupled with each of two secondary windings arranged in phase opposition with respect to one another such that, in operation, the net inductive coupling between the primary and secondary windings determines whether or not oscillation occurs in said oscillatory circuit; a reference member associated with one of the secondary windings for determining its coupling with the primary winding; and a movable detector member associated with the other secondary winding for influencing its coupling with the primary winding as a function of the movement of the detector member; the arrangement being such that, in operation, oscillation is respectively established and extinguished in said detector member in opposite directions through a critical position determined by said reference member.

An embodiment of the invention which is described in detail hereinafter comprises an oscillatory circuit including amplifier means, first inductive coupling means connected with said amplifier means to provide positive feedback therefor, second inductive coupling means connected with said amplifier means to provide negative feedback therefor, and a reference member and a movable detector member associated respectively with said first and second inductive coupling means for determining the coupling therethrough so that in use oscillatory signals are respectively established and extinguished in said oscillatory circuit on movement of said detector member in opposite directions through a critical position determined by said reference member, a transformer, including a primary winding connected with said amplifier means and first and second secondary windings connected in series in phase opposition with said amplifier means, constituting by its said first and second secondary windings the said first and second inductive coupling means respectively, said primary and first and second secondary windings being mounted on a single open magnetic core.

The invention will best be understood from consideration of the following description of a preferred embodiment thereof, described by way of example only with reference to the accompanying drawings wherein:—

Figure 1 is a schematic illustration of the preferred embodiment, and

Figure 2 is a circuit diagram of the preferred embodiment.

With reference to Figures 1 and 2, the first and second inductive coupling means of the preferred embodiment are formed respectively by the secondary windings 2 and 3 of a transformer. A primary winding 1 of the transformer is mounted, between the respective secondary windings, on an open magnetic core 5 and connected with the output of the amplifier means 9 which may, for example, comprise a transistor. The secondary windings are connected in series in phase opposition across the input to the amplifier means so that one of the windings provides negative feedback for the amplifier and the other provides positive feedback.

A screen 6 in the form of an aluminium tube partially shields the winding 2, its

position being adjustable in the axial direction to enable adjustment of the coupling between windings 1 and 2.

The detector member comprises a screen 7 also formed by an aluminium tube disposed coaxially with the winding 3 for axial movement to vary the coupling between the windings 1 and 3. Thus, movement of the screen 7 to a position in close proximity to the winding 3, or embracing the winding 3, partially short-circuits the magnetic flux between the windings 1 and 3 and thus reduces the feedback through winding 3. Thus, if winding 3 is connected to provide positive feedback, for example, oscillatory signals will be established in the oscillatory circuits when the screen 7 is moved away from the winding 3 to increase the coupling between the windings 1 and 3, and will be extinguished when the tube is moved towards winding 3 to reduce the coupling.

If the gain of the amplifier is high the critical position of the detector member will be that position at which the coupling between windings 1 and 3 is substantially equal to the coupling between windings 1 and 2. It will be appreciated, therefore, that the critical position of the detector member may be selected readily by suitably selecting the degree of coupling between windings 1 and 2 by means of screen 6. Moreover, provided the gain of the amplifier means is high, the critical position of the detector member is little affected by variations in the gain of the amplifier caused, for example, by variations in the ambient temperature, so that the apparatus functions accurately and reproducably in a wide range of ambient conditions. Furthermore, hysteresis in the critical position is slight, which is to say that the critical position of the detector member is substantially the same whether the member is moved backwards or forwards to establish or extinguish the oscillatory signals in the oscillatory circuit.

It will also be appreciated that no capacitator is included in the oscillatory circuit described, and this further extends the range of temperature within which accurate and reliable operation of the apparatus can be achieved.

In alternative embodiments of the invention, the screen 7 may be replaced by a ferro-magnetic element similar to the aluminium tube illustrated, and this would have the effect of increasing the coupling between the windings 1 and 3. Construction of the screen or ferro-magnetic element in the form of a tube enhances the precision with which the critical position is defined and allows a relatively long travel for the operating member. However, the screens 6 and 7 or ferro-magnetic element may be of any shape, particularly of plane shape if the required travel for the operating member is relatively short.

It may also be an advantage to dispose a shrouding 8 (shown in dotted lines) of ferro-magnetic material or simply of metallic material (conductor) round the detector, to avoid the influence of other metallic objects.

The transformation of the signal supplied by the oscillator to switch over a current may be effected in various known ways. Figure 2 shows one solution selected by way of example.

Winding 4, closely coupled with the primary winding 1, collects an alternating signal when the oscillator oscillates. Since this alternating signal generally does not have positive and negative alternations of equal duration, it is advisable to integrate it through the integrating circuit 10.

A comparator 11, which changes state on each passage through zero of the signal resulting from this integration, delivers symmetrical alternating control signals to an inverter 12. This inverter, under the control of the signals from comparator 11, converts a direct current supply into an alternating current supply which is applied to the primary winding of a transformer (not shown) providing d.c. isolation. The signal taken off at a secondary winding of the transformer is rectified at 13 and feeds, for example, the base of a power transistor 14, represented symbolically by a contact, and capable of controlling an external circuit.

WHAT WE CLAIM IS:—

1. A position detector comprising:— an oscillatory circuit including a primary winding inductively coupled with each of two secondary windings arranged in phase opposition with respect to one another such that, in operation, the net inductive coupling between the primary and secondary windings determines whether or not oscillation occurs in said oscillatory circuit; a reference member associated with one of the secondary windings for determining its coupling with the primary winding; and a movable detector member associated with the other secondary winding for influencing its coupling with the primary winding as a function of the movement of the detector member; the arrangement being such that, in operation, oscillation is respectively established and extinguished in said oscillatory circuit on movement of said detector member in opposite directions through a critical position determined by said reference member.

2. A position detector comprising an oscillatory circuit including amplifier means, first inductive coupling means connected with said amplifier means to provide positive feedback therefor, second inductive

coupling means connected with said amplifier means to provide negative feedback therefor, and a reference member and a movable detector member associated respectively with said first and second inductive coupling means for determining the coupling therethrough so that in use oscillatory signals are respectively established and extinguished in said oscillatory circuit on movement of said detector member in opposite directions through a critical position determined by said reference member, a transformer, including a primary winding connected with said amplifier means and first and second secondary windings connected in series in phase opposition with said amplifier means, constituting by its said first and second secondary windings the said first and second inductive coupling means respectively, said primary and first and second secondary windings being mounted on a single open magnetic core.

3. A position detector as claimed in claim 1 or 2 wherein said detector member comprises a metallic shield for one of said secondary windings movable to vary the degree of shielding thereof.

4. A position detector as claimed in claim 3 wherein said metallic shield is plane in shape.

5. A position detector as claimed in claim 3 wherein said metallic shield is tubular and mounted coaxially with said one of said secondary windings for axial movement to vary the degree of shielding thereof.

6. A position detector as claimed in claim 1 or 2 wherein said detector member comprises a ferro-magnetic element for movement to vary the magnetic coupling between said primary winding and one of said first and second secondary windings.

7. A position detector as claimed in claim 6 wherein said ferro-magnetic element is plane in shape.

8. A position detector as claimed in claim 6 wherein said ferro-magnetic element is tubular and disposed coaxially with said one of said secondary windings for axial movement to vary the magnetic coupling between said primary and said one of said secondary windings.

9. A position detector as claimed in claim 1 or any one of claims 3 to 8 as dependent upon claim 1 wherein said primary and first and second secondary windings are mounted on a single open magnetic core.

10. A position detector as claimed in any one of the preceding claims wherein said reference member comprises a metallic screen partially shielding the said first secondary winding and adjustable in position to vary the degree of shielding thereof whereby to vary said critical position of said movable member at which said oscillatory signals are established and extinguished.

11. A position detector as claimed in claim 10 wherein said metallic screen is plane in shape.

12. A position detector as claimed in claim 10 wherein said metallic screen is tubular and disposed coaxially with said other of said secondary windings.

13. A position detector substantially as herein described with reference to the accompanying drawings.

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1 SHEET

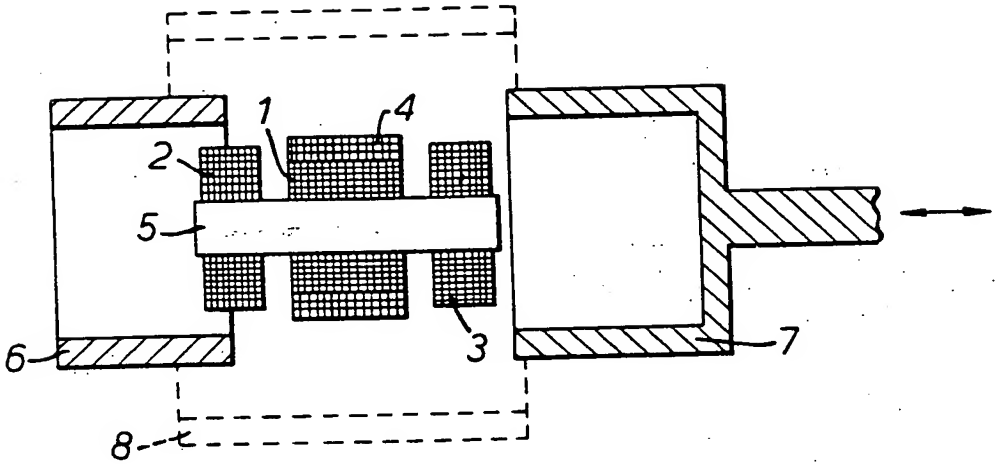

FIG. 1.

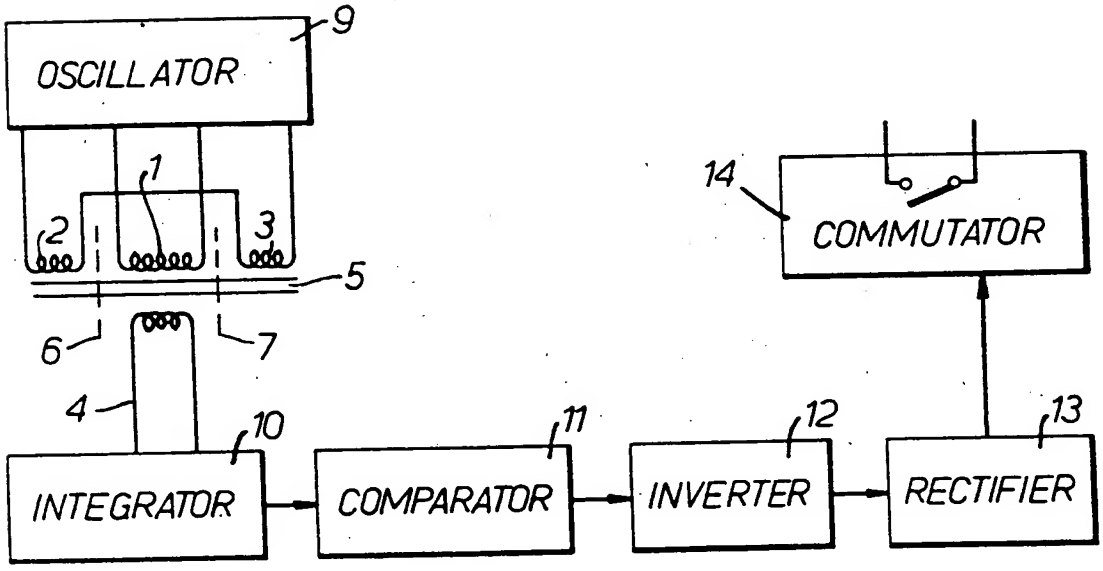

FIG. 2.